

**PUPA OF THE BEE *PARARHOPHITES OROBINUS*
(HYMENOPTERA: APOIDEA: MEGACHILIDAE)**

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Abstract.—The pupa of *Pararhophites orobinus* (Morawitz) (Pararhophitinae) is described, illustrated, and compared with the known pupae of other Megachilidae. The pupa is distinct from those of the megachilid subfamilies Fideliinae, Lithurginae, and Megachilinae. The similarities and differences of the pupae of the four subfamilies of the Megachilidae are discussed.

Because of the systematic significance of the palaearctic bee *Pararhophites* to the rest of the Megachilidae and because of its uncertain taxonomic placement in the past, a description of the pupa of *Pararhophites orobinus* (Morawitz) is recorded here, and its features are compared with those of other megachilids.

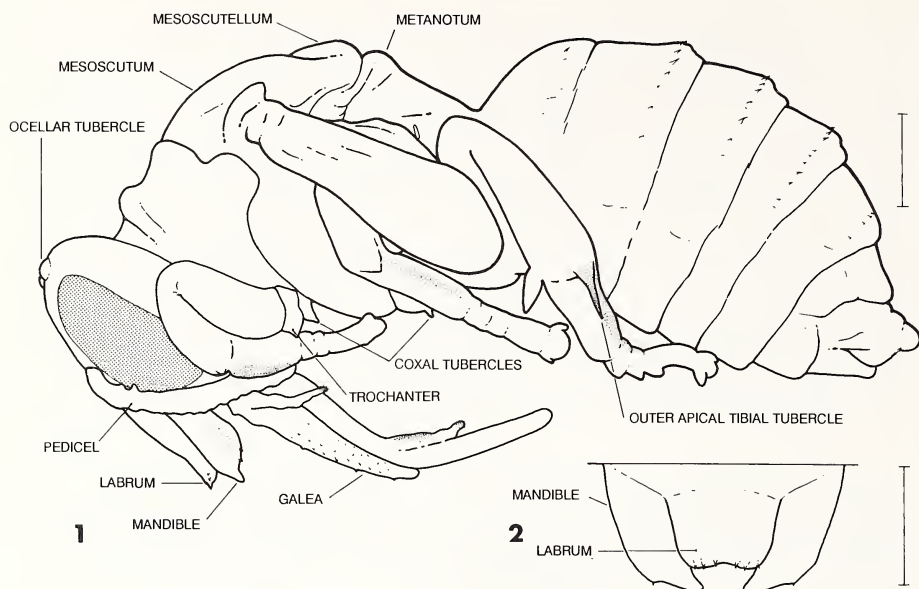
Until recently *Pararhophites* had been thought to be related to either the Anthophoridae or Melittidae (see McGinley and Rozen, 1987, for references). However, a study of the nesting biology and larvae of *Pararhophites orobinus* (Morawitz) suggested a very different relationship of the genus to the long-tongued bees. As a consequence McGinley and Rozen (1987) analyzed these relationships using adult and larval anatomy and biological features. We concluded that the genus was the sister group of the megachilid subfamilies Lithurginae, Megachilinae and also Fideliinae (considered by some authors as a separate family). The genus was placed in the monotypic subfamily Pararhophitinae as the basal clade in the Megachilidae.

I brought back live diapausing larvae from Pakistan in 1984 in the hope of being able to include pupae in our analysis, but no pupa developed by the time that study was published. Finally in September 1989, more than five years after being collected, one of the dozen remaining larvae pupated, perhaps making this specimen a record holder for the length of time a bee has survived as a diapausing larva that then pupated.

Pupa of Pararhophites orobinus
Figs. 1, 2

Diagnosis: The small tubercles on the galeae and labral apex are unique characters, not found in other bee pupae. These features, as well as the general lack of tubercles on the rest of the head and thorax, immediately set this pupa apart from pupae of many other bees. See Discussion for other pupal characters that distinguish the Pararhophitinae from the Megachilinae, Lithurginae and Fideliinae.

Head: Integument nonspiculate, smooth except microscopically granulate in patches on such places as lateral surface of mandibles, apex of palpi, and ventral surface of second segment of labial palpi; setae absent. Antenna without tubercles except pedicel



Figs. 1, 2. Pupa of *Pararhophites orobinus*. 1. Lateral view of body. 2. Frontal view of mandibles and labrum. Scale bars = 0.5 mm.

with small dorsal projection next to eye; vertex without tubercles, smooth; ocellar tubercles slightly developed; genal tubercle absent; frons and clypeus without tubercles; labrum long, flat, apically bilobed, and bearing series of small sharp-pointed tubercles along apical margin; mandible strongly swollen subapically as seen from side; this swelling bearing a few small sharp-pointed tubercles ventrally; mandibular apex faintly pigmented; galea bearing scattered small to very small tubercles, larger ones of which are sharp-pointed.

Mesosoma: Integument nonspiculate, mostly smooth but microscopically granulate in some places (as illustrated by stippling in Fig. 1), especially noticeable on lower surface of fore basitarsus, outer surface of mid basitarsus, outer apical tubercle of hind tibia, and dorsal surface of much of hind tarsus; setae absent. Lateral angles of pronotum not produced; posterior lobes of pronotum not produced but with integument along posterior edge pigmented; mesepisternum without tubercle; mesoscutum without tubercles or swelling and without midline groove; axillae and mesoscutellum not produced or tuberculate. Tegula without tubercles; wing without tubercles or swellings. Fore leg with coxa bearing pointed, moderate-sized tubercle arising from inner apex; trochanter with smaller apical tubercle; tibia with very small tubercle on outer apex; rest of fore leg without tubercles. Mid leg with coxa bearing moderately small, sharp-pointed apical tubercle; rest of mid leg without tubercles except for very small outer apical tubercle on tibia. Hind leg without tubercles except tibia with elongate, tapering tubercle arising from outer apex; this tubercle more elongate and slender than tibial spurs and allowing for development of long adult setae.

Metasoma: Integument nonspiculate; setae absent. Tergum I with indefinite trans-

verse band of a few irregularities and small sharp-pointed tubercles near apical margin; terga II–IV with more distinct transverse apical rows of small sharp-pointed tubercles, some of which are apically pigmented; tergum V with a few subapical tubercles; tergum VI without tubercles; sterna without tubercles and with transverse posterior margins; apex of abdomen rounded, not produced into elongated apical spine.

Material Studied: 1 female pupa, Killi Sarda, 12 km south of Quetta, Baluchistan, Pakistan, collected as larva May 14, 1984, pupated approximately September 14, 1989, drawn and described when discovered on September 21, 1989, as pale live pupa with pigmented eyes (J. G. Rozen, R. J. McGinley).

Discussion: Information about bee pupae is beginning to accumulate. Only two species of the Megachilidae (both in *Megachile*) were described by Michener (1954) in his seminal study of bee pupae. Since then, pupae of some taxa have been described, and specimens of others have been collected and are available for examination. The pupa of *Pararhophites orobinus* may shed light on the relationships of the genus to the rest of the Megachilidae. Its description supplements our comprehension of the subfamilies within the family and of the anatomical variation within the family.

Pupae of the Megachilinae (*Anthidiellum*, *Anthidianum* [?], *Stelis*, *Heterostelis*, *Hoplostelis*, *Dioxys*, *Chalicodoma*, *Heriades*, *Hoplitis*, *Osmia*, *Coelioxys*, *Megachile*) known to me or described in the literature (see McGinley, 1989, for references) lack tubercles on the vertex except for somewhat enlarged ocellar tubercles in some species. Distinct tubercles on the lateral lobes and angles of the pronotum are also missing, and there are no tubercles on the mesoscutum, mesoscutellum, or propodeum, except *Coelioxys* has a somewhat protuberant scutellum and enlarged axillae, corresponding to developing adult features. All known megachiline pupae bear conspicuous dorsal setae on the head, mesosoma, and metasoma.

Pupae of the Lithurginae are unknown except for those of *Lithurge chrysurus* Fonscolombe (Roberts, 1973) and *Trichothurgus dubius* (Sichel) (Rozen, 1973b). So far as is known they agree with the megachiline characteristics listed above, although they also have setae on their legs, a character which is not recorded for most Megachilinae. Conspicuous setae on vertex, mesonotum, and metasoma may be a synapomorphy of the Megachilinae and Lithurginae. However, this feature is not totally satisfactory because pupal setae, though microscopic and inconspicuous, occur in the Fideliinae. The pupa of *Neofidelia profuga* Moure and Michener (Rozen, 1973a) is setose, but the pupa of *Fidelia villosa* Brauns (Rozen, 1970) is not. The pupae of both *Neofidelia* and *Fidelia* share tegular tubercles, apparently a unique feature within the Megachilidae though found in other families. *Fidelia villosa*, alone among the megachilids, also has a median scutellar tubercle.

The pupa of *Pararhophites* stands apart from the other megachilids in that it does not bear either conspicuous or inconspicuous setae, it lacks tegular tubercles as well as scutellar tubercles, and, unlike any other known bee pupa, it has small tubercles on its galea and at the apex of its flat, bilobed clypeus. It shares the slender elongate tubercle arising from the outer apical edge of the hind tibia with the female pupa of *Neofidelia profuga* (Rozen, 1973a). This seems to be a convergence allowing for development of long adult bristles at the apex of the tibia in females of both *Neofidelia* and *Pararhophites*. A similar tubercle, also encasing adult setae, is found in the obviously unrelated *Hesperapis trochanterata* Snelling (Rozen, 1987) (Melittidae).

ACKNOWLEDGMENTS

This paper is an addendum to the 1987 study and the persons acknowledged there, as well as Dr. Ronald J. McGinley, are thanked here for their assistance. The Smithsonian Institution's Foreign Currency Program under the direction of Gretchen Ellsworth provided a grant for the field trip leading to this paper.

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Received October 11, 1989; accepted January 12, 1990.